

# THE FISHES OF THE GENUS *POMACENTRUS* IN FLORIDA AND THE WESTERN BAHAMAS<sup>1</sup>

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## INTRODUCTION

As already pointed out by Hildebrand (*in* Longley and Hildebrand, 1941: 177), the American Atlantic species of *Pomacentrus* have been the source of considerable confusion. Parr (1930: 67-83), the first to study the problem critically, laid the groundwork for future investigations. Later, Longley and Hildebrand (1941: 177-183), on the basis of field observations and the examination of freshly preserved material, indicated some of the difficulties, and greatly improved on the knowledge of the group. In spite of the latter contribution however, the recognition and identification of the species has been difficult and the nomenclatorial status of most of them has remained misunderstood.

The present study is a contribution towards the solution of the above mentioned problems. It is based on material mostly from South Florida and the Western Bahamas. The species discussed in this paper comprise all of those so far known from the Western Atlantic (Florida to Brazil). Owing to the geographical limitations of the material studied however, the present work is not intended as revisional.

Grateful acknowledgement is expressed to the following persons for their help in making the present study possible.

Madame L. Bauchot, Museum National d'Histoire Naturelle, Paris, France (MNHN), kindly sent taxonomic data and photographs of the types of *Pomacentrus fuscus*, *P. planifrons*, *P. variabilis* and *P. pictus*. Mrs. M. Dick, Museum of Comparative Zoology, Harvard University (MCZ), contributed valuable information on the types of *P. xanthurus* = *variabilis*, *P. analis* = *leucostictus* and *P. caudalis* = *leucostictus*. Miss Margaret Storey, Natural History Museum, Stanford University (SNHM), sent data on the types of *Eupomacentrus diencaeus* = *Pomacentrus variabilis*. Dr. Leonard P. Schultz, United States National Museum (USNM), loaned critical material from Bahia, Brazil and Tortugas, Florida.

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Mr. Wes Bartelt of Neptune Gardens, Marathon, Florida, collected and helped with the collection of material in the Florida Keys. Robert A. Martin, Senior Assistant in Ichthyology, University of Miami, helped with collections in the Biscayne Bay area. John S. Coles, Junior Assistant, contributed valuable material from Bimini, Bahamas. Mrs. Robert A. Martin, developed and printed some of the photographs.

With the exception of the material referred to above, the present study is based on the collections of the University of Miami Ichthyological Museum (UMIM). A total of 472 specimens were examined from Florida and the Western Bahamas. The number (in parentheses) following the Catalogue number, indicates the number of specimens in the lot.

#### METHODS

Measurements were made to the tenth of a millimeter with finely pointed vernier calipers graduated in millimeters.

The standard length was measured from the anterior tip of the upper lip (snout tip) to the middle of the caudal base. Unless otherwise indicated, the standard length is always stated as "length". The predorsal length, prepelvic length, preanal length, head length, snout length and maxillary length, were also measured from the snout tip to the following points: Predorsal length, to the origin of the erect dorsal fin; prepelvic length, to the insertion of the appressed, left pelvic fin; preanal length, to the origin of the erect anal fin; head length, to the tip of the opercular spine; snout length, to the nearest point on the fleshy margin of the orbit; maxillary length, to its posterior tip. The orbit diameter is the greatest horizontal distance between its anterior and posterior fleshy margins. The interorbital width is the shortest distance between the upper fleshy margins of the orbit. The suborbital width is measured at the posterior tip of the maxillary, to the nearest point on the fleshy margin of the orbit. The body depth is measured from the origin of the erect dorsal fin to the insertion of the appressed left pelvic fin. The caudal peduncle depth is the least depth. The pectoral and pelvic fin lengths were measured from their insertions to the tip of the appressed fin. The anal fin length was measured from the origin of the erect fin to its tip. The upper caudal lobe length was measured from the middle of the caudal base.

Proportions are expressed in thousandths of the length. The ontogenetic change of proportional characters is indicated in Table 1 by symbols in parentheses as follows. (I), means isometric, (A+), positively allometric and (A-), negatively allometric. A representative graded series, combining specimens from both Florida and the Bahamas, was used for each species in the construction of this Table.

The last two dorsal and anal rays were counted separately except when it was obvious that they were actually the branches of a single ray split to the base. All pectoral rays were counted. Cheek scale rows were counted as the number of scales along a line between the edge of the suborbital and the angle of the preopercle. Only the lateral line scales bearing a tube were counted.

Tables 2 to 5, expressing the frequency distribution and variation of meristic characters, are based on all the material examined, except specimens less than about 30 mm. in length.

#### GENERIC STATUS

The species considered in the present study belong to the pantropical group of pomacentrids characterized by the following combination of characters: Lateral line incomplete, terminating under posterior part of dorsal fin; teeth compressed, close-set, in a single series; suborbital and preopercle serrate; dorsal spines, 12; lateral line scales bearing tubes, 15 to 22. This group has generally been included by most authors in the genus *Pomacentrus* Lacépède (1802: 508). Jordan and Evermann (1898: 1549, 1550) and later Jordan, Evermann and Clark (1930: 413) however, included the American species under the nominal genus *Eupomacentrus* Bleeker (1877: 73) on the basis of the single row of teeth, as opposed to an inner series of a few teeth in *Pomacentrus* (*sensu stricto*).

A survey of the literature shows that usually, the species with uniserial teeth have 12 dorsal spines and those with an inner series have 13 spines. The type species of *Pomacentrus*, *Chaetodon pavo* Bloch (1787: 44), has 13 dorsal spines and an inner series of teeth, whereas *Chaetodon lividus* Bloch and Schneider (1801: 235), the type species of *Eupomacentrus*, has 12 dorsal spines and a single row of teeth. Both these species occur throughout the Indo-Pacific, from the Red Sea and western Indian Ocean eastward to the Marquesas.

All of the thirteen currently accepted nominal American species (five Atlantic, eight Pacific), have 12 dorsal spines and uniserial teeth, but at least five Indo-Pacific species and one Hawaiian have the same combination of characters.

It would seem from the above, that *Eupomacentrus* may be acceptable as a valid genus, but certainly not to only include the American species as proposed by Jordan and Evermann (*loc. cit.*) Pending a world-wide revision of the group, the species herein discussed are retained in the genus *Pomacentrus*.

#### EVALUATION AND SIGNIFICANCE OF TAXONOMIC CHARACTERS

The most obvious and striking taxonomic characters involve general and detailed features of coloration, some of which apparently have been overlooked in the past. Each species has its own distinctive color pattern especially in life and most of the diagnostic color features remain even after years of preservation. An attempt has been made in this study to correlate the permanency or change of color, between freshly (10% formalin) and long-preserved (70% alcohol) material, with the following results.

The grey, black, yellow, orange or dark-blue ground colors, gradually change to corresponding intensities of brown after a few years of preservation. The lateral dark bars and the dark spot on the dorsal fin, back of caudal peduncle (supracaudal spot) and pectoral base, remain distinct after more than one hundred years of preservation, as shown by the types of *Pomacentrus pictus*, *P. fuscus*, *P. planifrons* and *P. variabilis*. Blue spots, streaks and lines on the head and body, gradually become dark-brown, but the smaller blue spots on the dorsal and anal fin eventually fade. Pale or colorless areas of the body or fins remain unchanged.

Certain features of the color pattern appear to be constant and do not show variation within a species. Others may show variation correlated with growth or sex.

With some exceptions, proportions are rather uniform and not very significant as diagnostic characters (Table 1). The prepelvic length, caudal peduncle depth, orbit diameter and interorbital width, are about the same in all the five species. The other proportional characters overlap one another, but many of them show significant mean differences between two or more species.

The number of dorsal and anal rays is about the same in all of the species (except *Pomacentrus leucostictus*), but pectoral ray and lateral line scale counts show some significant differences despite the broad overlap (Tables 2-5).

The material examined shows a definite correlation between color pattern and proportional and meristic characters. In addition, the mean proportional and meristic differences among these forms become even more significant in expressing specific distinction, on the basis of geographical, ecological and behavioral relationships.

The species discussed in the present study are sympatric and occupy the same general habitat (syntopic). They are abundant in shallow water around coral stacks, stone piles and crevices along rocky shores, or even in small tidal pools. With the proper technique, most of the species can be collected together in restricted areas no larger than a city block. Representatives of all of five species were recently collected between Key Vaca (Marathon) and Sombrero Reef, Florida Keys, a distance of about four nautical miles and depths ranging from two to fifteen feet.

Numerous underwater observations conducted by me indicate that some of the species may have microhabitat preferences. In areas where several or all five species occur together however, they are always in close association and when frightened, one or more individuals of several species may seek refuge in the same crevice.

In the light of the above, these forms appear as truly distinct genetic entities rather than variants of one or two species (Meek and Hildebrand, 1925: 700; Breder, 1927: 54; Beebe and Tee-Van, 1928: 195; Parr, 1930: 67-82). Most of the so-called "extreme", "intermediate", or questionable individuals, are referable to some species, but a few seem to represent hybrids, a possibility suggested by Parr (*loc. cit.*) and discussed in the last section of the present study.

The material studied indicates that the total complement of diagnostic characters for all species, is not established until the individuals reach a length of about 30 mm. Smaller specimens however, can be identified by a process of elimination and comparison with the tables and descriptions.

TABLE 1.  
 PROPORTIONAL CHARACTERS OF THE SPECIES OF *POMACENTRUS* FROM FLORIDA  
 AND THE WESTERN BAHAMAS.

| Character                    | <i>P. pictus</i> |      | <i>P. fuscus</i> |      | <i>P. planifrons</i> |      | <i>P. variabilis</i> |      | <i>P. leucostictus</i> |      |
|------------------------------|------------------|------|------------------|------|----------------------|------|----------------------|------|------------------------|------|
|                              | Range            | Mean | Range            | Mean | Range                | Mean | Range                | Mean | Range                  | Mean |
| Number of specimens          | 22               |      | 23               |      | 6                    |      | 24                   |      | 24                     |      |
| Standard length              | 31-56.5          | 41.1 | 30-72            | 51.2 | 31.6-77.8            | 50.2 | 29.7-74              | 40   | 30.0-77.5              | 48.3 |
| Predorsal length (A-)        | 363-420          | 384  | 401-446          | 422  | 422-453              | 437  | 396-452              | 426  | 355-411                | 383  |
| Prenasal length (I)          | 632-686          | 660  | 640-733          | 680  | 687-730              | 707  | 638-703              | 667  | 643-698                | 671  |
| Prepelvic length (I)         | 380-416          | 394  | 386-427          | 399  | 386-426              | 408  | 388-438              | 406  | 370-404                | 386  |
| Head length (A-)             | 303-331          | 316  | 299-347          | 322  | 322-352              | 334  | 311-356              | 336  | 294-335                | 315  |
| Snout length (I)             | 77-95            | 86   | 82-99            | 92   | 98-111               | 104  | 86-107               | 97   | 83-97                  | 91   |
| Maxillary length (I)         | 80-92            | 86   | 84-97            | 90   | 93-105               | 97   | 94-111               | 101  | 83-100                 | 93   |
| Orbit diameter (A-)          | 99-128           | 115  | 92-120           | 103  | 100-133              | 114  | 97-125               | 113  | 83-123                 | 105  |
| Suborbital width (A+)        | 29-39            | 32   | 32-42            | 37   | 40-47                | 44   | 30-43                | 33   | 26-42                  | 33   |
| Interorbital width (I)       | 88-107           | 98   | 99-113           | 104  | 94-119               | 107  | 92-110               | 101  | 88-111                 | 95   |
| Body depth (A+)              | 443-493          | 469  | 469-524          | 497  | 478-551              | 511  | 450-495              | 475  | 416-477                | 445  |
| Caudal peduncle depth (I)    | 140-158          | 148  | 149-168          | 157  | 147-155              | 151  | 145-169              | 154  | 142-165                | 152  |
| Pectoral fin length (I)      | 269-310          | 288  | 289-331          | 307  | 302-326              | 316  | 281-321              | 301  | 249-292                | 271  |
| Pelvic fin length (A-)       | 312-368          | 340  | 284-367          | 326  | 324-368              | 349  | 316-394              | 352  | 316-403                | 360  |
| Anal fin length (I)          | 406-499          | 452  | 335-396          | 368  | 396-465              | 416  | 368-426              | 398  | 390-470                | 433  |
| Upper caudal lobe length (I) | 366-459          | 402  | 339-407          | 377  | 317-392              | 352  | 317-367              | 336  | 324-390                | 360  |

TABLE 2  
 FREQUENCY DISTRIBUTION OF NUMBER OF DORSAL RAYS, IN THE  
 SPECIES OF *POMACENTRUS* FROM FLORIDA AND  
 THE WESTERN BAHAMAS.

| Species                | No. | 13 | 14 | 15 | 16 | 17 | Range | Mean  |
|------------------------|-----|----|----|----|----|----|-------|-------|
| <i>P. fuscus</i>       | 148 |    | 2  | 57 | 87 | 2  | 14-17 | 15.6  |
| <i>P. variabilis</i>   | 57  |    | 3  | 23 | 29 | 2  | 14-17 | 15.53 |
| <i>P. planifrons</i>   | 7   |    |    | 3  | 3  | 1  | 15-17 | 15.71 |
| <i>P. pictus</i>       | 46  |    | 1  | 26 | 18 | 1  | 14-17 | 15.41 |
| <i>P. leucostictus</i> | 123 | 1  | 9  | 78 | 35 |    | 13-16 | 15.19 |

TABLE 3  
 FREQUENCY DISTRIBUTION OF NUMBER OF ANAL RAYS, IN THE  
 SPECIES OF *POMACENTRUS* FROM FLORIDA AND  
 THE WESTERN BAHAMAS.

| Species                | No. | 12 | 13 | 14 | 15 | Range | Mean  |
|------------------------|-----|----|----|----|----|-------|-------|
| <i>P. fuscus</i>       | 148 |    | 71 | 75 | 2  | 13-15 | 13.53 |
| <i>P. variabilis</i>   | 57  | 1  | 20 | 32 | 4  | 12-15 | 13.68 |
| <i>P. planifrons</i>   | 7   |    | 1  | 6  |    | 13-14 | 13.86 |
| <i>P. pictus</i>       | 46  |    | 14 | 30 | 2  | 13-15 | 13.74 |
| <i>P. leucostictus</i> | 123 | 3  | 81 | 39 |    | 12-14 | 13.29 |

TABLE 4  
 FREQUENCY DISTRIBUTION OF NUMBER OF PECTORAL RAYS,  
 IN THE SPECIES OF *POMACENTRUS* FROM FLORIDA  
 AND THE WESTERN BAHAMAS.

| Species                | No. | 17 | 18 | 19 | 20 | 21  | 22 | Range | Mean  |
|------------------------|-----|----|----|----|----|-----|----|-------|-------|
| <i>P. fuscus</i>       | 148 |    |    |    | 15 | 106 | 27 | 20-22 | 21.08 |
| <i>P. variabilis</i>   | 57  |    | 1  | 16 | 38 | 2   |    | 18-21 | 19.71 |
| <i>P. planifrons</i>   | 7   |    |    | 6  | 1  |     |    | 19-20 | 19.14 |
| <i>P. pictus</i>       | 46  |    | 5  | 35 | 6  |     |    | 18-20 | 19.02 |
| <i>P. leucostictus</i> | 123 | 1  | 74 | 48 |    |     |    | 17-19 | 18.38 |

TABLE 5  
 FREQUENCY DISTRIBUTION OF NUMBER OF LATERAL LINE  
 SCALES, IN THE SPECIES OF *POMACENTRUS* FROM  
 FLORIDA AND THE WESTERN BAHAMAS.

| Species                | No. | 17 | 18 | 19 | 20  | 21 | Range | Mean  |
|------------------------|-----|----|----|----|-----|----|-------|-------|
| <i>P. fuscus</i>       | 148 |    | 3  | 19 | 125 | 1  | 18-21 | 19.7  |
| <i>P. variabilis</i>   | 57  |    | 2  | 28 | 27  |    | 18-20 | 19.43 |
| <i>P. planifrons</i>   | 7   |    | 1  | 3  | 3   |    | 18-20 | 19.28 |
| <i>P. pictus</i>       | 46  |    | 2  | 11 | 30  | 3  | 18-21 | 19.73 |
| <i>P. leucostictus</i> | 123 | 1  | 24 | 66 | 32  |    | 17-20 | 19.04 |

The following key combines the most diagnostic color, proportional and meristic characters, as a preliminary step towards identification.

### KEY

1a.—Anterior half to four fifths of body very dark, the posterior half to fifth, more or less abruptly light-colored; dark and light coloration extending on dorsal and anal fin. Dark marking on insertion of pectoral fin present and conspicuous, extending downward as an elongate blotch to or beyond middle of pectoral base. Dark spot on dorsal fin and on back of caudal peduncle, always absent. Tip of anal fin reaching beyond vertical from tip of dorsal fin. Snout equal to or less than three-fourths of orbit. Cheek scales in 3 rows.

#### 1. *Pomacentrus pictus*

1b.—Color pattern of body not as above. Dark marking on insertion of pectoral fin obsolete or reduced to a spot at upper end of pectoral base. Dark spot on dorsal fin always present in young, sometimes persisting in adults. Dark spot on back of caudal peduncle present or absent. Tip of anal fin not reaching beyond vertical from tip of dorsal fin. Snout greater than three-fourths to about equal orbit. Cheek scales in 4 rows.

2a.—Vertical dark stripes on sides of body and caudal peduncle, present and conspicuous. Streaks or lines on top of snout, interorbital or nape absent. Rows of spots on nape, back or upper sides of body absent. Anal fin about equal to or shorter than upper caudal lobe; reaching to or slightly beyond vertical from caudal base. Pectoral rays 20 to 22, usually 21, rarely 20.

#### 2. *Pomacentrus fuscus*

2b.—Vertical dark stripes on sides of body present or absent; obsolete or absent on sides of caudal peduncle. Streaks or lines on top of snout, interorbital or nape, present or absent. Rows of spots on nape, back or upper sides of body, present or absent. Anal fin longer than upper caudal lobe; reaching well beyond vertical from caudal base. Pectoral rays 17 to 21, rarely 21.

3a.—Scaled sheath of spinous dorsal fin without spots. Top of snout, interorbital, nape and back without streaks or lines, sometimes with a few scattered spots. Dorsal fin spot when present (young), about equal to or larger than eye, its lower half extending on back, usually to lateral line. Back not abruptly darker than rest of body. Anterior profile steep, slightly convex to nearly straight in adults. Body depth about one half of length or greater in adults. Pectoral rays usually 19, rarely 18 or 20.

#### 3. *Pomacentrus planifrons*

3b.—Scaled sheath of spinous dorsal fin profusely spotted. Top of snout with two diverging streaks in adult, occurring as



parallel lines on top of snout, interorbital and nape in young; nape and back with longitudinal rows of spots. Dorsal fin spot when present (young), smaller than eye, not extending on back, or only its lower third or fourth. Back more or less abruptly darker than rest of body in young, sometimes in adults. Anterior profile not steep, always strongly convex. Body depth less than half of length in young and adults. Pectoral rays usually 18 or 20, rarely 17 or 21.

4a.—Dorsal fin spot when present (young), low, its lower third or fourth extending on back. Spot on back of caudal peduncle present, sometimes obsolete. Spot at insertion of pectoral fin diffuse or obsolete. Vertical dark bars on sides of body, present and conspicuous. Pectoral rays 19 to 21, usually 20.

4. *Pomacentrus variabilis*

4b.—Dorsal fin spot when present (young), high, not in contact with back. Spot on back of caudal peduncle always absent. Spot at insertion of pectoral fin present and conspicuous. Vertical dark bars on sides of body usually absent, diffuse when present. Pectoral rays 17 to 19, usually 18.

5. *Pomacentrus leucostictus*

1. *POMACENTRUS PICTUS* Castelnau

*Figures 1, 5*

*Pomacentrus pictus* Castelnau, 1855: 9 (original description; Brazil, pl. 2, fig. 1.

*Pomacentrus partitus* Poey, 1868: 327 (original description; Cuba). Howell-Rivero, 1938: 208 (holotype in MCZ, no. 14680). Longley, in Longley and Hildebrand, 1941: 180 (habitat, coloration, nesting habits, range; Tortugas, Florida). Briggs, 1958: 283 (listed, range; Florida).

*Eupomacentrus partitus*, Jordan and Evermann, 1898: 1558 (description after Poey; Cuba). Jordan, Evermann and Clark, 1930: 414 (listed, range).

*Pomacentrus freemani* Beebe and Tee-Van, 1928: 196 (original description, comparisons, figure; Port-au-Prince Bay, Haiti). Parr, 1930: 80, 81 (compared with *P. partitus*; Bahamas).

*Pomacentrus fuscus* forma C Parr, 1930: 68-83 (description, comparisons, comments, material; Bahamas), figs. 16, 17.

The original description of *Pomacentrus pictus* was given by Castelnau in the following sentence: "Diffère du précédent [*Pomacentrus variabilis*] par sa couleur entièrement noire et sa queue dont la partie supérieure est d'un jaune-citron". This statement is too short and inadequate to enable full recognition, but it does seem to eliminate *Pomacentrus fuscus*, *P. planifrons*, *P. variabilis*

and the young and females of *P. leucostictus*. It is interesting to note that Castelnau himself recognized *fuscus* as distinct from his *variabilis* and *pictus*.

Recognition of the present species is now possible through a study of the type, 70.5 mm. in length, from Bahia, Brazil (MNHN 8280), based on detailed data including a photograph (Figure 1) sent by Mme. Bauchot. After 110 years in alcohol, the general coloration is very dark-brown. There is no spot on the dorsal fin or the back of the caudal peduncle. The pectoral fins are colorless, but their bases are very dark-brown. The lower caudal lobe is very dark, with the exception of the median rays. The upper lobe is colorless like the pectorals. The other fins are dark-brown, like the general coloration of the body.

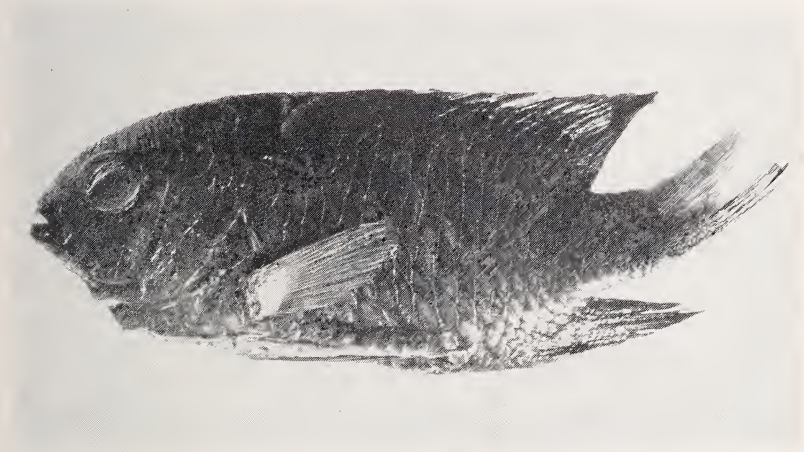


Figure 1. *Pomacentrus pictus*. Holotype, 70.5 mm. in length from Bahia, Brazil, MNHN 8280. (Photograph, courtesy of Mme. Bauchot).

The Florida and Bahamas material referable to the present species, is in general agreement with the type in color pattern, especially the larger specimen, 56.5 mm. in length, which has been in alcohol for twelve years (UMIM 102, Bimini, Bahamas). The very dark-brown pectoral base (black in life and freshly preserved material) is diagnostic of the species and is shown in Castelnau's figure. The pectoral fin is lemon-yellow in life and freshly preserved specimens, as also shown by Castelnau in his figure. This character is also diagnostic of the species. In *Pomacentrus fuscus*,

*P. variabilis* and *P. leucostictus*, the pectoral fins are colorless even in life, but they are sometimes yellow in *P. planifrons*. In the latter species however, a supracaudal spot is always present and conspicuous, but always absent in *P. pictus*.

The color pattern of this species is quite distinctive and strikingly different from that of the other four. Extensive variation in the extent of the dark and light areas of the body and fins may occur, as shown by Parr (1930: 75, fig. 17). This may explain the rather unusual color pattern of the caudal fin of the type, as shown by Castelnau's figure and as indicated in his original description.

The available material is also in agreement with the type in the diagnostic proportional characters by which the species is distinguished from the other four (Table 1). In the type, the snout is less than three-fourths of the orbit diameter and the tip of the anal fin reaches beyond a vertical from the tip of the dorsal. The tips of the fins, except the pelvics, appear to be somewhat damaged and their lengths are therefore unreliable. The pelvic fin length is 341. Other body proportions of the type are as follows: Pre-dorsal length, 397; prepelvic length, 412; head length, 291; orbit diameter, 99; caudal peduncle depth, 142. The left pectoral fin has 19 rays and the right, 20. There are 19 lateral line scales and 3 rows of cheek scales. The latter character is diagnostic.

From the original description and the holotype (MCZ 14680), *Pomacentrus partitus* Poey may be readily recognized as a synonym of *P. pictus*. Longley, in Longley and Hildebrand (1941: 180), synonymized *P. freemani* with *P. partitus* without comment. This however, had been previously established by Parr (1930: 80, 81).

The caudal lobes in *Pomacentrus pictus* are acute and usually quite sharply pointed or even filamentous, especially the upper lobe. The soft dorsal and anal fin are also very pointed. The anal fin is frequently filamentous and extends well beyond a vertical from the caudal base, usually by a distance about equal to or greater than the snout length.

The typical color pattern of the body is established at a length of about 15 mm. and the diagnostic dark blotch on the pectoral base, at about 25 mm. Streaks or lines on the snout, interorbital or nape, are always absent, as well as rows of spots on the back and upper sides of body. Dark, vertical stripes may be present in some specimens, but they are confined to the dark areas of the sides of the

body. The caudal fin is usually pale but occasionally it may be wholly or partly dusky to very dark. In contrast with the other four species, the dorsal fin spot is never present in the young or adult. The absence of a spot on the back of the caudal peduncle, is a character shared with *Pomacentrus leucostictus*. The coloration in life has been described by Longley, *in* Longley and Hildebrand (1941: 180).

In addition to the characters given in the key, the present species differs from the other four in the longer anal fin and upper caudal lobe (Table 1). It is intermediate in meristic characters (Tables 2-5), except the number of cheek scale rows.

Forty-six specimens were examined from the following localities. Bimini Harbor, Bahamas: UMIM 102 (1); UMIM 2881 (6). Molasses Reef, Florida: UMIM 2833 (13). Sombrero Reef, Florida: UMIM 2848 (26).

## 2. POMACENTRUS FUSCUS Cuvier and Valenciennes

### *Figures 2, 6*

*Pomacentrus fuscus* Cuvier and Valenciennes, 1830: 324 (original description, comparison, internal anatomy; Brazil). Briggs, 1958: 283 (listed, range; Florida).

*Pomacentrus adustus* Troschel, *in* von Muller, 1865: 633 (original description; comparisons; Atlantic coast of Mexico). Longley and Hildebrand, 1941: 178 (comparisons, description, reproduction; Tortugas, Florida). Briggs, 1958: 283 = *variabilis* (listed, range; Florida).

*Pomacentrus dorsopunicus* Poey, 1868: 328 (original description; Cuba).

*Pomacentrus obscuratus* Poey, 1876: 101 (original description; Cuba). Howell-Rivero, 1938: 208 (types in MCZ, no. 14681).

*Eupomacentrus fuscus*, Jordan and Evermann, 1898: 1552 (description, comments, range; Key West and Bahia).

*Pomacentrus fuscus* forma D Parr, 1930: 69-83 (description, comparison, comments, material; Bahamas), fig. 18.

*Eupomacentrus rubridorsalis* Beebe and Hollister, 1931: 85 (original description, comments; Chatham Bay, Union Island, Grenadines), fig. 16. Beebe and Tee-Van, 1933: 189, 190 (description, figure, range; Bermuda).

As pointed out by Longley (*in* Longley and Hildebrand, 1941: 178), the present species has been frequently misinterpreted or not fully recognized. This is further emphasized by the above synonymy and the additional nomenclatorial confusion introduced by Longley himself (*loc. cit.*).

Measurements, counts and a photograph (Figure 2) of the holotype of *Pomacentrus fuscus* (MNHN 8281), have been received from Mme. Bauchot. The specimen, in good state of preservation, measures 87 mm. in length and was collected in Brazil by Delalande. The proportions and counts are as follows. Predorsal length, 443. Preanal length, 730. Prepelvic length, 402. Head length, 305. Snout length, 92. Maxillary length, 90. Orbit diameter, 92. Suborbital width, 41. Body depth, 472. Caudal peduncle depth, 155. Pectoral fin length, 293. Pelvic fin length, 345. Anal fin length, 374. Upper caudal lobe length, 368. Dorsal spines, 12. Dorsal rays, 15; anal, 13; pectoral, 21 (erroneously stated as 18 in the original description). Lateral line scales, 20.

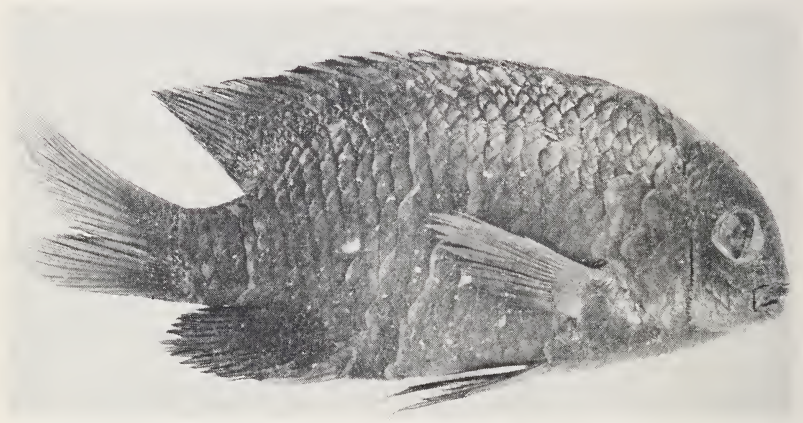


Figure 2. *Pomacentrus fuscus*. Holotype, 87 mm. in length from Brazil, MNHN 8281. (Photograph, courtesy of Mme. Bauchot).

Comparison of the above proportions and counts with those of the Florida and Bahamas specimens (see tables), leaves no doubt as to their being conspecific. The vertical, dark stripes on the sides of the body and caudal peduncle, a diagnostic character, are present in the holotype of *Pomacentrus fuscus*. After more than 130 years in preservation, the general coloration of the type is described by Mme. Bauchot (*in litt.*) as: “. . . brun doré y compris les nageoires D, A, C, V. Membrane interradiare de la dorsale épineuse frangée de brun foncé. Pectorales claires”. Three specimens, 46.4, 81 and 91 mm. in length from Bahia, Brazil (USNM 43327), have been examined and found to be in agreement with the holotype and the Florida and Bahamas material.

The assignment of the present species to *Pomacentrus adustus* by Longley (*loc. cit.*), was probably due to his failure to study the type of *P. fuscus*. The original description of *fuscus* is not detailed enough to recognize the species and contains the erroneous and misleading statement of 18 pectoral rays. Longley's attempt to dismiss the ". . . true *fuscus* . . ." as a larger fish, without much comment or proof, is hardly valid. The Brazilian specimens referred to above are no larger than the larger specimens examined from Florida and the Bahamas.

Attempts to locate the type of *Pomacentrus adustus* have met with failure, but the original description clearly refers to the present species, as shown by Longley (*loc. cit.*). Although the number of pectoral rays was stated as "19" by Troschel, it is quite possible that one or two of the very small, close-set lowest rays, might have been missed. Troschel's attempt to distinguish *adustus* from *fuscus* on the basis of body depth, number of fin rays and geographical distribution, is not valid in the presence of the new evidence.

The identity of *Pomacentrus dorsopunicus*, *P. obscuratus* and *P. rubridorsalis* (see synonymy above), with the present species, has already been shown by Longley (*l.c.*).

The Bahamas material referred to by Parr (1930: 69-83) as "forma D", is obviously *Pomacentrus fuscus* as he himself clearly demonstrated on the basis of color pattern and proportions. Failure to consider meristic characters however, probably prevented his arriving at a full understanding of this and some of the other species.

In *Pomacentrus fuscus*, the dorsal fin spot, the supracaudal spot and the vertical stripes on the sides of the body, are already evident at a length of about 12 mm. The dorsal fin spot and supracaudal spot however, begin to fade at a length of about 35 to 40 mm. and entirely disappear at a length of 45 to 50 mm. The dorsal fin spot is usually smaller than the eye and only its lower third or fourth extends on the back and never to the lateral line. Streaks or lines on the upper part of the snout, interorbital or nape, are never present in the young or adult. Rows of spots on the back are always absent, but the young usually have a few scattered round dots on the snout and the interorbital space. The general coloration is uniformly light to dark-brown or nearly black. The pectoral fin is colorless but the other fins are dusky and usually darker than the body,

especially the dorsal and the anal. The life colors have been well described by Longley (*in* Longley and Hildebrand, 1941: 179).

In the present species, the soft dorsal and anal fin are rounded and the latter sometimes extends somewhat beyond a vertical from the caudal base, by a distance not greater than the pupil diameter. The upper caudal lobe is occasionally somewhat pointed but the lower is always rounded.

This species differs from the other four in the number of pectoral rays, shorter pelvic and anal fin and in the presence of vertical, dark bars on the sides of the caudal peduncle.

In addition to the material referred to above, one hundred and seventy-six specimens were examined from the following localities. Ocean side, South Bimini, Bahamas: UMIM 635 (52). Ocean side, North Bimini, Bahamas: UMIM 631 (7). Anguilla Island, Cay Sal Bank, Bahamas: UMIM 373 (63). Elbow Cay, Cay Sal Bank, Bahamas: UMIM 378 (1). Cay Sal, Cay Sal Bank, Bahamas: UMIM 389 (1). Nicholls Town, North Andros Island, Bahamas: UMIM 1808 (7). Biscayne Bay, Miami, Florida: UMIM 375 (1). Ocean side, Key Largo, Florida; UMIM 2813 (7). Virginia Key, Miami, Florida: UMIM 2909 (3). Molasses Reef, Florida Keys: UMIM 2831 (22). Sombrero Reef, Florida Keys: UMIM 2847 (10). Port Henderson, Jamaica: UMIM 388 (2).

### 3. POMACENTRUS PLANIFRONS Cuvier and Valenciennes

#### *Figures 3, 7*

*Pomacentrus planifrons* Cuvier and Valenciennes, 1830: 323 (original description, comparison, comments; Martinique). Longley, *in* Longley and Hildebrand, 1941: 178 (comparisons), 180, 181 (coloration in life, comparisons, eggs, nesting habits; Tortugas, Florida). Briggs, 1958: 283 (listed, range; Florida).

*Eupomacentrus planifrons*, Jordan and Evermann, 1898: 1559 (description after Cuvier and Valenciennes; Martinique). Jordan, Evermann and Clark, 1930: 414 (listed, range).

*Eupomacentrus chrysus* Bean, 1906a: 32 (original description; Bermuda); 1906b: 61, fig. 4. Beebe and Tee-Van, 1933: 189 (description, figure; Bermuda).

*Pomacentrus fuscus* forma B, Parr, 1930: 68-83 (description, comparison, comments, material; Bahamas), fig. 15.

The present species is hardly recognizable from the original description, except for the statement concerning the “. . . à peu près rectiligne . . .” anterior profile, which is diagnostic. Full recognition is now possible through a study of the holotype, 60

mm. in length, collected in Martinique by Plée. Measurements, counts and a photograph (Figure 3) of the specimen (MNHN 547) were furnished by Mme. Bauchot. A study of the photograph and the measurements, indicate that the type specimen is malformed in the region of the caudal peduncle and the anal base. The caudal peduncle is unusually short, as indicated in the original description. For this reason, the measurements are not reliable, but the large, dark, saddle-like spot on the back of the caudal peduncle, clearly present in the holotype, is diagnostic of the species. The counts for the holotype are as follows. Dorsal spines, 12. Dorsal rays, 15; anal, 13; pectoral, 19. Lateral line scales, 18.

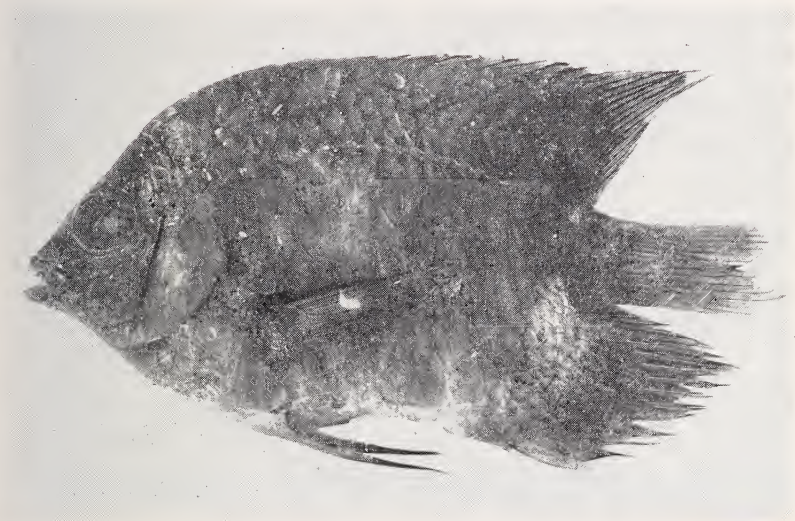


Figure 3. *Pomacentrus planifrons*. Holotype, 60 mm. in length from Martinique, MNHN 547. (Photograph, courtesy of Mme. Bauchot).

Longley (in Longley and Hildebrand, 1941: 180), synonymized *Eupomacentrus chrysus* with *Pomacentrus planifrons* without comment. This seems to be well justified since the original description and figure of *chrysus* clearly refer to the present species, as already suspected by Parr (1930: 80).

Parr (1930: 79, 80), discussed eleven large specimens of questionable relationship and arrived at the tentative conclusion that they were referable to his formae B (*planifrons*), D (*fuscus*) or both. He also considered the possibility that these questionable speci-



mens might represent an unrecognized form. Parr's specimens 4, 5 and 8, with ". . . vertical striations and . . . a sharply marked, saddle-like supracaudal spot . . .", were 82, 80 and 72 mm. in length respectively. At this large size, the color pattern indicates that these specimens could only be *Pomacentrus planifrons* or *P. variabilis*. His table of proportional characters (*loc. cit.*: 73) shows the suborbital width as 4.2 percent of the length for specimen 8, and 3.7 and 3.8 respectively for specimens 4 and 5. The suborbital width is a markedly positive allometric character and at those lengths, the above percentages would correspond with *planifrons* or *variabilis*. When the "distance from snout to dorsal" (predorsal length) and the body depth of these questionable specimens is analyzed in the same manner, it becomes apparent that specimen 8 is *Pomacentrus planifrons* and specimens 4 and 5, *P. variabilis*. In regard to color, as correlated with size, the remaining eight questionable specimens could be *P. fuscus*, *P. variabilis*, *P. leucostictus* or a mixture of all three. Further application of the above method of analysis however, shows that on the basis of head length, suborbital width, predorsal length and body depth (see Table 1), specimens 1, 2, 6, 7 and 9, are probably *fuscus*, 10 and 11, *variabilis* and 3, *leucostictus*. The supracaudal spot is sometimes absent or obsolete in *variabilis*, but the lateral, vertical bars are always present and conspicuous. Large males of *leucostictus* are uniformly brownish black, sometimes with slight indications of vertical striations (as described by Parr) and resemble very closely the adults of *fuscus* (see below, under *Pomacentrus leucostictus*).

The material at hand indicates a definite correlation between the nearly straight anterior profile, the broader suborbital and the presence of a supracaudal spot and lateral bars, in the larger adults of *Pomacentrus planifrons*. The young and half-grown up to about 50 mm. in length, can always be distinguished from those of the other four species, by the extent and larger size of the dorsal fin spot as described in item 3a of the key. Half-grown and adults 40 mm. in length or larger, can always be recognized by the greater body depth and the nearly straight anterior profile. Critical examination of a graded series of *P. planifrons* from 26 mm. young to 78 mm. adult, shows a gradual ontogenetic change and discloses no questionable specimens that might be confused with another

species. The dorsal spot fades and disappears at a length of about 50 to 60 mm. The supracaudal spot and the lateral bars are always present and persist in the adult. The back is never abruptly darker than the rest of the body.

Eight specimens were examined from the following localities. Sombrero Reef, Florida Keys: UMIM 2850 (6). Bimini Harbor, Bahamas: UMIM 103 (1); UMIM 2880 (1).

#### 4. *POMACENTRUS VARIABILIS* Castelnau

*Figures 4, 8*

*Pomacentrus variabilis* Castelnau, 1855: 9 (original description; Brazil), pl. 3, fig. 3.

*Pomacentrus xanthurus* Poey, 1860: 190 (original description; Cuba); 1868: 326 (coloration; Cuba). Howell-Rivero, 1938: 207 (cotypes in MCZ, no. 14677a). Longley and Hildebrand, 1941: 177 (recognized as valid species), 179, 180 (comparison), 181 (synonymy, characters, comparison, distribution; Tortugas, Florida), 182 (comparison). Briggs, 1938: 283 (listed, range; Florida).

*Pomacentrus flaviventer* Troschel, in von Müller, 1865: 633 (original description; Atlantic coast of Mexico). Longley and Hildebrand, 1941: 178, 179, 181 (comparisons; synonym of *P. xanthurus*).

*Eupomacentrus diencaeus* Jordan and Rutter, 1898: 116 (original description; Jamaica). Jordan and Evermann, 1898: 1552 (description, comparison; Jamaica). Jordan, Evermann and Clark, 1930: 413 (listed; Jamaica).

*Eupomacentrus nepenthe* Nichols, 1921: 1 (original description; Berry Islands, Bahamas), fig. 1.

Since its original publication in 1855, until the present, the name *variabilis* has remained overlooked or misconstrued as applying to the present species. Although far too brief and inadequate, the original description and figure offer several clues towards partial recognition. From his comments, it would seem that Castelnau had obtained specimens from the fish market in which the dark-blue of the back (fresh specimens) would gradually turn dark-brown. The rest of the body however, would remain yellow. He also mentions the presence of a round black spot “. . . sur le dos, en avant de la nageoire . . .” without specifying which fin. Obviously, this refers to either the dorsal fin spot or the supracaudal spot, probably the latter. The above combination of color characters would seem to eliminate *Pomacentrus fuscus* and *P. pictus*, and the presence of a supracaudal spot would eliminate *P. leucostictus*.

The species may be now fully recognized through a study of the types from Bahia, Brazil, based on data sent by Mme. Bauchot, including a photograph (Figure 4). There are two specimens, 70.5 and 73 mm. in length (MNHN 8135), of which the longer is here designated as the lectotype (Figure 4). They both have a dorsal fin spot overlapping the back and a well marked spot on the back of the caudal peduncle. As already indicated, these spots disappear at a length of 45 to 50 mm. in *Pomacentrus fuscus* and are always absent in *P. pictus*. The dorsal fin spot disappears at a length of 50 to 60 mm. in *P. planifrons*. In *P. leucostictus*, the dorsal fin spot is not in contact with the back in specimens longer than 25 mm. and entirely disappears at a length of 55 mm. The supracaudal spot is always absent in *P. leucostictus*. The general coloration of the types of *P. variabilis* is described (*in litt.*) by Mme. Bauchot as follows: "La tinte générale du corps est brun clair, y compris les nageoires, sauf le bord de la membrane interradiaire de la Dorsale qui est brun plus foncé. Il semble qu'il y ait des rayures transversales plus sombres correspondant aux rangées d'écaillés, mais l'alteration des couleurs dans l'alcool (depuis 110 ans) rend cet examen difficile."

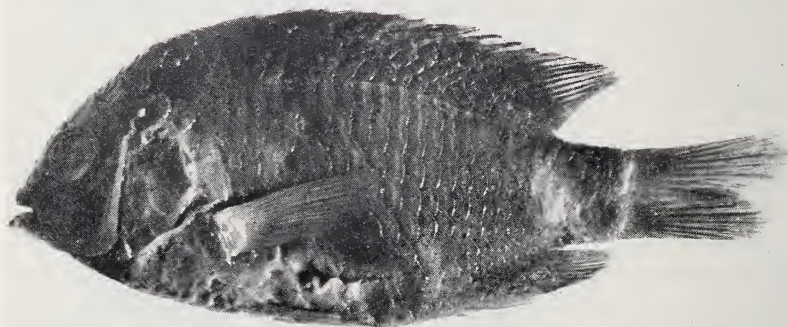


Figure 4. *Pomacentrus variabilis*. Lectotype, 73 mm. in length from Bahia, Brazil, MNHN 8135. (Photograph, courtesy of Mme. Bauchot).

The Florida and Bahamas material is also in agreement with the types, in diagnostic proportional characters. In the types of *variabilis*, the body depth is 466 and 469. In two specimens, 59.6

and 74 mm. in length from Biscayne Bay and Sombrero Reef, Florida, respectively, the body depth is 465 and 493. In two specimens of *Pomacentrus fuscus*, 66 and 72 mm. from Molasses Reef, Florida Keys, the body depth is 524 and 514 respectively. In two specimens of *P. planifrons*, 63 and 77.8 mm. from Sombrero Reef, Florida Keys, the body depth is 500 and 506 (see also Table 1). Comparison of other proportional characters on the basis of the same specimens follows. Predorsal length: *P. variabilis*, 397, 411 (types); 406, 410; *P. fuscus*, 422, 414; *P. planifrons*, 422, 425. Upper caudal lobe length: *P. variabilis*, 305, 315 (types); 324, 317; *P. fuscus*, 349 (damaged in 72 mm. specimen); *P. planifrons*, 343, 347. Both types of *P. variabilis* have 21 pectoral rays and 20 lateral line scales.

A study and comparison of the material at hand with the original description and types of *Pomacentrus xanthurus*, indicates that the latter is conspecific with *P. variabilis*. Data on the types of *xanthurus* (MCZ 4677a) including a photograph, have been received from Mrs. M. Dick. There are three specimens in good condition, 68, 79 and 80 mm. in length, of which the smallest is the holotype. The pectoral fin, which in *variabilis* is longer than in *leucostictus* (Table 1), has the following lengths for the types: 294 (holotype), 304 and 300. The anal fin and upper caudal lobe are shorter in *variabilis* than in *leucostictus* and have the following lengths for the cotypes (apparently damaged in the holotype): Anal fin, 368, 375; upper caudal lobe, 317, 338. The anal fin in *variabilis* is longer than in *fuscus* and shorter than in *pictus* and *planifrons*. The upper caudal lobe is shorter in *variabilis* than in *planifrons*, *fuscus* and *pictus*, especially the latter. Counts for the holotype and the two cotypes of *xanthurus* are as follows. Dorsal spines, 12. Dorsal rays, 15; anal, 13; pectoral, 19 (holotype), 20, 19. Lateral line scales, 20.

The identity of *Pomacentrus flaviventer* with *P. xanthurus* = *variabilis*, previously recognized by Longley and Hildebrand (*loc. cit.*), is now further confirmed by the material at hand and the original description of *flaviventer*.

Longley (*in* Longley and Hildebrand, *loc. cit.*), synonymized *Eupomacentrus diencaeus* with *Pomacentrus adustus* = *fuscus* without comment. The original description of *diencaeus* and the comments by Jordan and Evermann (1898: 1553) however, indicate that this nominal form is conspecific with *Pomacentrus variabilis*.

This is now confirmed by measurements and counts of the types of *diencaeus* (SNHM 4969) made available by Miss Margaret Storey. There are two specimens 81 and 81.2 mm. in length, with the following proportions and counts. Predorsal length, 377, 419. Body depth, 495, 497. Pectoral fin length, 290, 306. Anal fin length, 443, 432. Pectoral rays, 20. These proportions and counts are diagnostic of *Pomacentrus variabilis*.

The inclusion of *Eupomacentrus nepenthe* in the synonymy of *Pomacentrus leucostictus* by Longley (l.c.), does not seem to be justified. The original description and figure of *nepenthe* indicate that this nominal species is apparently conspecific with *Pomacentrus variabilis*. As described in items 4a and 4b of the key and below, the dorsal fin spot persists in the adult and overlaps the back in *variabilis* but not in *leucostictus*. In *nepenthe*, the dorsal fin spot is described and figured as overlapping the back. In addition, the holotype of *nepenthe* is 61 mm. in length and at this size, the dorsal spot has disappeared in *leucostictus*. The “. . . shallow concavity . . .” in the anterior profile of the type of *nepenthe*, is apparently an artifact in preservation. In pomacentrids, as in many other groups of fishes, rigor mortis from slow death before immersion in preservative, causes upturning of the head resulting in a concavity along the anterior profile.

The material from Tortugas, Florida (USNM 61066), referred to *Pomacentrus xanthurus* by Hildebrand (*in* Longley and Hildebrand, l.c.), has been examined. There are five specimens of which two, 46 and 76 mm. in length, are *variabilis* and three, 58, 67 and 72 mm., are *leucostictus*. Both of the *variabilis* specimens have 20 pectoral rays and a black spot on the back of the caudal peduncle. The smaller specimen still bears the dorsal fin spot partly overlapping the back. The *leucostictus* specimens have 19 pectoral rays and no spot on the back of the caudal peduncle; the smallest specimen has the spot high up on the dorsal fin, not in contact with the back.

Caldwell and Briggs (1957: 4), tentatively referred to *Pomacentrus xanthurus* fifty-one specimens 11 to 59 mm. in length, collected in Panama City, Florida. Judging from their comments on coloration, it would seem that these authors had *P. fuscus* or perhaps a mixture of two or more species.

Owing to the misinterpretations hitherto involved in the application of the name *variabilis*, the identity of the material so re-

corded by Springer and Woodburn (1960: 69) needs verification. No diagnosis or other taxonomic clues are given in that publication.

The dorsal fin spot, vertical dark bars on the sides, streaks and lines on the head, and body and fin spotting, are already evident at a length of 15 to 18 mm. in *Pomacentrus variabilis*. The supracaudal spot appears at a length of about 22 mm. and although persisting in the adult, it may be obsolete or absent in some specimens regardless of size. In 46 specimens 22 to 74 mm. in length chosen at random from the Florida and Bahamas material, the spot was present in 35, obsolete in 7 and absent in 4. The dorsal fin spot always partly overlaps the back and may become obscure in larger adult specimens. The lateral bars are always present and conspicuous. The back is always more or less abruptly darker (blue in life) than the rest of the body which is light colored (orange-yellow in life).

In addition to material discussed above, sixty-seven specimens were examined from the following localities. Ocean side, North Bimini, Bahamas: UIMM 642 (1). Ocean side, South Bimini, Bahamas: UIMM 645 (5). Anguilla Island, Cay Sal Bank, Bahamas: UIMM 376 (26). Boca Raton Inlet, Florida: UIMM 2728 (1). Biscayne Bay, Miami, Florida: UIMM 379 (1). Virginia Key, Miami, Florida: UIMM 2907 (8); UIMM 3146 (3). Molasses Reef, Florida Keys: UIMM 2834 (1). Sombrero Reef, Florida Keys: UIMM 2849 (21).

## 5. POMACENTRUS LEUCOSTICTUS Müller and Troschel

### Figure 9

- Pomacentrus leucostictus* Müller and Troschel, 1848: 674 (original description, comparison; Barbados). Longley, in Longley and Hildebrand, 1941: 178, 180 (comparisons), 181-183 (comparisons, synonymy in part, occurrence, description, sexes, breeding habits; Tortugas, Florida). Briggs, 1958: 283 (listed, range; Florida).
- Pomacentrus otophorus* Poey, 1860: 188 (original description; Cuba); 1868: 326 (coloration; Cuba).
- Pomacentrus atrocyaneus* Poey, 1860: 190 (original description; Cuba); 1868: 327 (coloration, body depth; Cuba).
- Pomacentrus analis* Poey, 1868: 327 (original description; Cuba). Howell-Rivero, 1938: 208 (holotype in MCZ, no. 14678).
- Pomacentrus caudalis* Poey, 1868: 328 (original description; Cuba). Howell-Rivero, 1938: 208 (types in MCZ, no. 14682).
- Pomacentrus analis* forma *xanthus* Metzelaar, 1919: 98 (description; Curaçao; Bonaire; St. Eustatius).
- Pomacentrus fuscus* forma A Parr, 1930: 68-83 (description, comparison, comments, material; Bahamas), fig. 14.
- Pomacentrus fuscus* forma E Parr, 1930: 68-83 (description, comparison, comments, material; Bahamas), fig. 19.

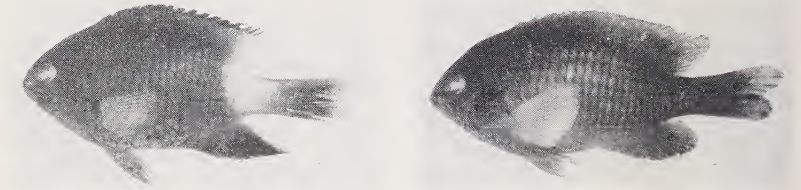


Figure 5. (left). *Pomacentrus pictus*. Freshly preserved adult, 46 mm. in length from Molasses Reef, Florida Keys, UIMM 2833. (Photograph by the author).

Figure 6. (right). *Pomacentrus fuscus*. Freshly preserved adult, 65.3 mm. in length from Molasses Reef, Florida Keys, UIMM 2831. (Photograph by the author).

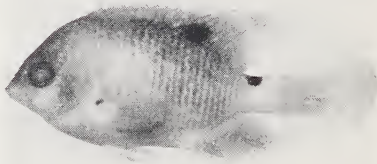


Figure 7. *Pomacentrus planifrons*. Freshly preserved adult, 48.5 mm. in length from Sombrero Reef, Florida Keys, UIMM 2850. (Photograph by the author).

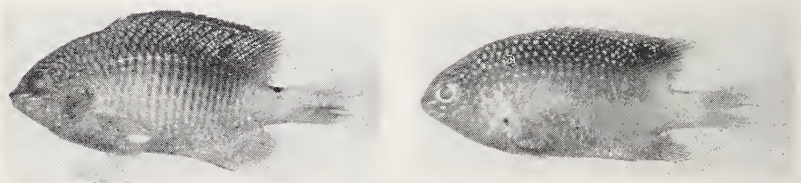


Figure 8. (left). *Pomacentrus variabilis*. Freshly preserved adult, 59.6 mm. in length from Sombrero Reef, Florida Keys, UIMM 2849. (Photograph by the author).

Figure 9. (right). *Pomacentrus leucostictus*. Freshly preserved adult, 52.2 mm. in length from ocean side of Key Largo, Florida, UIMM 2814. (Photograph by the author.)

The original description separates *Pomacentrus leucostictus* from *P. pictus*, *P. fuscus* and *P. planifrons*, but not from *P. variabilis*. Later however, Troschel himself (in von Müller, 1865: 633) recognized the differences between his *P. flaviventer* = *variabilis* and *P. leucostictus* and thereby made the latter fully recognizable. The type or types of *leucostictus* have apparently been lost.

The original description of *Pomacentrus otophorus* indicates that this nominal species was probably based on a large adult male of *P. leucostictus*. The size correlated with the coloration, the anterior profile, the elongation of vertical fins and the number of pectoral rays are all diagnostic of *leucostictus*. The type is not found at the Museum of Comparative Zoology which is the usual depository of Poey's types (Howell-Rivero, 1938). Many of Poey's type specimens however, originally believed lost, have later been located at the U. S. National Museum.

Jordan and Evermann (1898: 1552), synonymized *Pomacentrus atrocyaneus* with *P. fuscus*, but later Longley (in Longley and Hildebrand, 1941: 181) included *atrocyaneus* in the synonymy of *leucostictus*. The type of *atrocyaneus* is apparently not available, but the original description indicates that it was probably based, as *otophorus*, on an adult male of *leucostictus*.

As already indicated by Longley (l.c.), *Pomacentrus analis* appears to be a synonym of *P. leucostictus*. Mrs. Dick has examined the material (MCZ 14678) of *analis* reported by Howell-Rivero (1938: 208) as the holotype. She reports that there are three specimens, 18, 38 and 41 mm. in length. These specimens have 18, 18 and 17 pectoral rays respectively, a spot on the dorsal fin, no spot on the back of the caudal peduncle and no lateral stripes. In addition, there are two other lots sent by Poey as *P. analis* (MCZ 14676 and 14679). There are three specimens, 52, 60 and 60 mm. in length, in lot 14676. These have 18, 18 and 19 pectoral rays respectively and no lateral stripes or a dorsal or supracaudal spot. Lot 14679 comprises a single specimen 69 mm. in length, with 18 pectoral rays, no lateral stripes and no dorsal or supracaudal spot. A standard length of 69 mm. would correspond to a total length of about 95 mm., as stated by Poey for the specimen on which his original description of *Pomacentrus analis* was based. It would seem therefore, that this specimen, MCZ 14679, is the holotype of *analis*, not MCZ 14678 as stated by Howell-Rivero (l.c.).



Mrs. Dick has also examined Poey's types of *Pomacentrus caudalis* (MCZ 14682). There are seven specimens, 15, 17, 25, 26, 29, 32 and 40 mm. in length. The 25 mm. specimen has 19 pectoral rays and a dorsal and supracaudal spot; it is probably *P. variabilis*. The rest of the specimens have the dorsal fin spot but no supracaudal spot or lateral stripes. They have 18 or 19 pectoral rays and the 40 mm. specimen is probably the holotype and only specimen on which the original description of *caudalis* was based. This nominal form is apparently also a synonym of *Pomacentrus leucostictus* as indicated by Jordan and Evermann (1898: 1557).

On the basis of color pattern, proportions and the figure, *Pomacentrus fuscus* forma A represents *P. leucostictus* as Parr himself suspected and demonstrated. His forma E, apparently is also *leucostictus* and seems to have been based on poorly preserved specimens. As already discussed for *Pomacentrus nepenthe* (see above under *P. variabilis*), stiffening of the body produced by rigor mortis before preservation, causes upturning of the head and straightening of the anterior profile. In addition, the general background color becomes paler and features such as spots, streaks and lines are more or less faded. The upturning of the head produces artificial lengthening of the body and shortening of the anterior profile. As a result of this, the body depth and the predorsal length appear to be smaller. These characters were used by Parr to distinguish his forma E, in addition to the lighter color and lack of regular markings. He also indicated that specimen 3 of his forma E, showed ". . . some very faint, minute dots, which, according to their arrangement might possibly be interpreted as identical with the dorsal dots of forma A [*leucostictus*]." As already suggested by Parr (1930: 80), *Pomacentrus analis* forma *xanthus* Metzelaar is similar to his forma E, and probably for the same reasons discussed above.

According to the material examined, the dorsal fin spot is already evident and conspicuous in *Pomacentrus leucostictus*, at a length of 10 mm. and it fades and disappears at a length of about 40 to 55 mm. At a length of about 25 mm., the dorsal spot is high on the fin and no longer in contact with the back. At the same length, the spot at the base of the pectoral fin is already present as well as the numerous dots on the scaly sheath of the dorsal fin. The streaks and lines on the snout, interorbital, nape and back, appear at a length of about 15 mm. and the rows of spots on the back and upper

sides of body are already evident at a length of about 20 mm. The spot on the back of the caudal peduncle is always absent in *P. leucostictus*.

In the young of both sexes, up to about 40 mm. in length, the back is dark (blue in life) and shades more or less abruptly to light (yellow in life) on the rest of the body. Adult males about 40 mm. in length or larger, are uniformly very dark including the fins except the pectorals. In this respect they resemble *Pomacentrus fuscus* but can always be distinguished by the low pectoral ray count, the more slender body, the shorter pectoral fin and the longer anal fin. In adult females, the body is less uniformly dark than in adult males, the belly and lower sides being lighter and the caudal peduncle and caudal fin much lighter than the rest. Vertical dark stripes may occasionally be present in both males and females, but they are much less conspicuous than in the other species and are absent on the sides of the caudal peduncle. The occurrence of sexual dichromatism in *P. leucostictus* was first shown by Longley (in Longley and Hildebrand, 1941: 182). A detailed description of the coloration in life is given by him in that publication.

The fewer pectoral rays correlated with a more slender body and shorter pectoral fins, diagnose *Pomacentrus leucostictus* and distinguish it from the other four species.

One hundred and fifty-five specimens were examined from the following localities. Bimini Harbor, Bahamas: UMIM 372 (24); UMIM 622 (1); UMIM 2878 (29). Ocean side, North Bimini, Bahamas: UMIM 821 (3); UMIM 2884 (5). Ocean side, South Bimini, Bahamas: UMIM 643 (6). Anguilla Island, Cay Sal Bank, Bahamas: UMIM 371 (49). Nicholls Town, North Andros, Bahamas: UMIM 2683 (1). Virginia Key, Miami, Florida: UMIM 2907 (7). Cape Florida, Biscayne Key, Miami, Florida: UMIM 782 (1). Ocean side, Key Largo, Florida Keys: UMIM 2814 (6). Molasses Reef, Florida Keys: UMIM 2832 (1). Sombrero Reef, Florida Keys: UMIM 2852 (21).

#### PROBABLE HYBRIDS

During the process of sorting and identification of the material reported upon in this paper, six specimens were found which did not agree with any of the species. These specimens range from 22.5 to 40.2 mm. in length and they all represent the same form. Further study and comparison indicate that this material may be

interpreted as representing a hybrid form rather than an undescribed species.

The assumed hybrids appear to be more or less intermediate between *Pomacentrus planifrons* and *P. leucostictus*. These two species differ significantly in at least six proportional characters (Table 6), but meristic differences do not seem to be significant enough to be considered. The hybrids have 16 dorsal rays, 14 anal rays, 19 or 20 pectoral rays and 19 lateral line scales. Although not easily measurable, the curvature of the anterior profile is strikingly different between *P. planifrons* and *P. leucostictus*. It is straight or nearly so in *planifrons* but strongly convex in *leucostictus*. The hybrids show an intermediate condition in this respect also.

Several features of the coloration are also markedly different between *Pomacentrus planifrons* and *P. leucostictus*. In *planifrons*, the lower half of the dorsal fin spot extends on the back whereas in *leucostictus* it is placed high up on the fin and is not in contact with the back. In the hybrids, the dorsal fin spot is intermediate in position. Streaks, lines and rows of spots on the head and upper sides of the body are absent in *planifrons* but present and conspicuous in *leucostictus*. In the hybrids, these characters appear to be intermediate. In specimens of *planifrons* of about the same size as the hybrids, the ground color is uniformly light (saffron-yellow in life). In specimens of *leucostictus* of corresponding size, the back and dorsal parts of the head are very dark (blue in life) in sharp contrast with the rest of the body which is very light (yellow in life). In the hybrids, these color features are again, intermediate. The supracaudal spot is large and conspicuous in *planifrons* but absent in *leucostictus*. In the hybrids, the supracaudal spot appears to be absent, but careful microscopic examination of that area shows a noticeable intensification of pigmentation in some of the specimens. The possibility exists that the supracaudal spot may be a recessive character in *planifrons* and that if so, it therefore would not appear in the present assumed hybrid form. A good life-color photograph of the hybrid, was recently published by Straughan (1960: 5), under the name of "honey demoiselle".

Application of the "hybrid index" developed by Hubbs and Kuronuma (1942: 291) indicates various degrees of intermediacy in the hybrids (Table 6). When all the mean hybrid indices for

TABLE 6  
 COMPARISON OF *POMACENTRUS PLANIFRONS* X *P. LEUCOSTICTUS* HYBRIDS WITH PARENTAL SPECIES.

| Character            | <i>P. planifrons</i> |      | Hybrids   |      | <i>P. leucostictus</i> |      | H. Index |
|----------------------|----------------------|------|-----------|------|------------------------|------|----------|
|                      | Range                | Mean | Range     | Mean | Range                  | Mean |          |
| Number of specimens  | 4                    |      | 6         |      | 6                      |      |          |
| Standard length      | 26.2-47.0            | 34.6 | 22.5-40.2 | 31.5 | 23.0-42.0              | 32.0 |          |
| Predorsal length     | 439-453              | 449  | 426-467   | 440  | 384-435                | 408  | 22       |
| Preal length         | 687-730              | 706  | 675-719   | 698  | 646-695                | 681  | 32       |
| Body depth           | 478-551              | 514  | 454-514   | 486  | 416-478                | 454  | 47       |
| Suborbital width     | 27-45                | 34   | 22-31     | 27   | 22-30                  | 26   | 88       |
| Pectoral fin length  | 310-326              | 317  | 294-316   | 305  | 276-318                | 291  | 46       |
| Dorsal spot diameter | 115-174              | 136  | 87-147    | 123  | 51-100                 | 76   | 22       |

each proportional character are averaged however, the total mean hybrid index is 43, which is fairly close to perfect intermediacy (50).

As pointed out by Hubbs (1955: 17-19), spawning time and area, mating behavior, cohabitation and relative abundance of potential parental species, appear to be significant in conditioning natural hybridization. These conditions, as they apply to *Pomacentrus planifrons* and *P. leucostictus*, seem to be favorable in leading to natural hybridization, according to the following discussion.

As indicated by Longley (*in* Longley and Hildebrand, 1941: 178-183) and underwater observations by the present writer, the Florida and Bahamas species of *Pomacentrus* spawn at the same time, at least during June and July. The extent of the spawning season for the individual species is not known. According to Longley (l.c.), reproduction in *P. adustus* = *fuscus*, continues actively in August and the material examined for the present study, contains specimens of *P. variabilis* and *P. leucostictus* as small as 18 and 14 mm. in length respectively, collected in August. It is interesting to note that the smallest hybrid (22.5 mm.) was collected in June (Bimini, Bahamas), the next largest (26.5 mm.) in early August (Molasses Reef, Florida Keys) and a series of three (30, 34 and 35.5 mm.), in November (Cay Sal Bank, Bahamas). The largest specimen (40.2 mm.) was collected in late August (Bimini, Bahamas).

In addition to synchronous spawning, these species frequently occur together in close association, as already discussed in the section on taxonomic characters. Furthermore, their very close morphological relationship would seem to indicate that they are also closely related genetically and physiologically.

As to the occurrence and relative abundance of the assumed parental species and hybrids, in the areas where the latter were collected, the following conditions seem to be significant. The 22.5 mm. specimen (UMIM 3122) from the ocean side of South Bimini, Bahamas, was collected with six specimens of *Pomacentrus leucostictus* 12 to 52 mm. in length (UMIM 643). The 40.2 mm. specimen (UMIM 2883) from Bimini Harbor, was collected with 29 specimens of *leucostictus* 20 to 58 mm. (UMIM 2878) and one specimen of *planifrons* 26 mm. in length (UMIM 2880). Previous collecting in the same area had yielded 24 specimens of *leucostictus* 20 to 59 mm. in length (UMIM 372) and one specimen of *planifrons*, 61.5 mm. in length (UMIM 103), but no hybrids. The three 30, 34 and

35.5 mm. specimens (UMIM 3121) from Anguilla Island, Cay Sal Bank, Bahamas, were collected with 49 specimens of *leucostictus*, 9 to 61 mm. in length (UMIM 371). The 26.5 mm. specimen (UMIM 3123), was collected at Molasses Reef, Florida Keys, with one specimen of *leucostictus*, 55 mm. in length (UMIM 2832). It is also significant, that the six hybrids represent only 1.3 percent of the total number of specimens (472) examined in this study.

Underwater observations by myself and several collectors of "marine tropicals" (personal communications), indicate that although their vertical distribution overlaps, *Pomacentrus planifrons* is rarer and occurs at greater depths than *P. leucostictus*. These two species are easily recognized in the field by trained collectors who refer to *planifrons* as the "orange demoiselle" and to *leucostictus* as the "beau gregory". At the time of collection in Molasses Reef, a few specimens of *planifrons* were seen in deeper water (fifteen feet), but not taken, due to the limitations of the equipment (face-mask, snorkel and hand nets). In shallower water however (six feet), most of the specimens seen and taken, were *Pomacentrus pictus* but very few *leucostictus*, of which only one was taken. Later, at Sombrero Reef, a similar condition was observed. In this locality however, intensive collecting in deeper water (fifteen feet) with "aqualung" and hand nets, produced six specimens of *planifrons* and twenty-six of *pictus*. No *Pomacentrus fuscus*, *variabilis* or *leucostictus* were seen in this area, but these species were later found in relative abundance in shallower water (two to six feet) not far away.

The occurrence and relative abundance in areas of contact, of *Pomacentrus planifrons* and *P. leucostictus*, as discussed above, would seem conducive to hybridization between these two species. Hybridization would also seem possible between other pairs of species in the group, but the material at hand has not revealed any other possible hybrids.

Admittedly, the above analyses and comments are not critical enough to allow definite conclusions. Experimental work is required before hybridization in *Pomacentrus* (and other groups of fishes) is established. The possibility of breeding pomacentrids under controlled laboratory conditions, has been demonstrated by Garnaud (1957: 211).

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